Express Mail Label No.: EV 368752390 US
Date Mailed: March 19, 2004

UNITED STATES PATENT APPLICATION FOR GRANT OF LETTERS PATENT

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IMAGE FORMING DEVICE HAVING A DOOR ASSEMBLY AND METHOD OF USE

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IMAGE FORMING DEVICE HAVING A DOOR ASSEMBLY AND METHOD OF USE

Background

Image forming devices require user intervention for proper operation. One user intervention is clearing the media path during a paper jam. Access to the media path is often difficult because of the complex mechanical design in existing devices. The media path may be located within the interior of the device making it very difficult to remove a jammed media sheet. Further, the user may have access to a limited section of the media path and be able to remove only a portion of the jammed media sheet. A torn remainder is left in the device that must somehow be removed prior to restarting image formation.

Another user intervention requires mounting cartridges within the device. Cartridge mounting may occur initially when the machine is first used, or throughout the device life to replace exhausted cartridges. The complex design again makes it difficult for the user to access the cartridges. Difficult cartridge mounting locations may also result in the user getting toner on their hands and fingers by inadvertently contacting the toner outlet on the cartridge.

Some existing devices provide for an adjustable media path and cartridge mounts to ease the user intervention. The media path and cartridge mounts may be positionable between an operational position during image formation, and a non-operational position to ease user access for media jam removal and cartridge installation respectively. It is important that these adjustable elements be accurately located in the operational position. Inaccurate locating of the elements may result in image forming defects, increased media jams, and other detrimental effects.

Further, the device should be constructed in an economical manner. Price is one of the leading factors when a user makes a purchasing decision. Improvements to user intervention should add to functionability, but not at a price that will drive away potential users.

Summary

The present invention is directed to a door assembly on an image forming device. The door assembly is positionable between open and closed orientations to position a cartridge unit relative to a body of the device.

In one embodiment, the invention includes a first frame pivotally mounted to the body at a first pivot and positioned between open and closed orientations. A second frame is pivotally connected to the first frame at a second pivot. In an open orientation, the second frame is spaced from the body and moved relative to the first frame. In the closed orientation, the first frame is moved inward with the second frame being registered relative to the body.

In another embodiment, the device comprises a body with a developer member. A first frame is connected to the body at a first pivot with the first frame being positioned between a first orientation with a second end distanced from the body, and a second orientation with the second end in proximity to the body. A second frame having a photoconductive member is attached to the first frame at a second pivot. The second frame pivots separately from the first frame to position the photoconductive member in contact with the developer roll when the first frame is in the second orientation.

In another embodiment, a number of developer members are positioned within the body and a number of photoconductive members are positioned on the second frame. Each of the photoconductive members has substantially the same travel length as the first frame and second frame are moved from an intermediate orientation to a closed orientation.

Brief Description of the Drawings

Figure 1 is a schematic view of an image forming device according to one embodiment of the present invention;

Figure 2 is a cross-sectional view of an image forming unit according to one embodiment of the present invention;

Figure 3 is a is a cut-away side view of a door in an open orientation according to one embodiment of the present invention;

Figure 4 is a schematic view of the door in the open orientation according to one embodiment of the present invention;

Figure 5 is a schematic view of the door in an intermediate orientation according to one embodiment of the present invention;

Figure 6 is a schematic view of the door in a closed orientation according to one embodiment of the present invention;

Figure 7 is a cut-away partial side view of the frame contacting the main body according to one embodiment of the present invention;

Figure 8 is a schematic view of a one-piece image forming unit with the door assembly in an open orientation according to one embodiment of the present invention; and

Figure 9 is a schematic view of the device of Figure 8 with the door assembly in a closed orientation according to the present invention.

Detailed Description

Figure 1 depicts a representative image forming device, such as a printer, indicated generally by the numeral 10. The image forming device 10 comprises a main body 12 and a door assembly 13. A media tray 98 with a pick mechanism 16, or a multi-purpose feeder 32, are conduits for introducing media sheets into the device 10. The media tray 98 is preferably removable for refilling, and located on a lower section of the device 10.

Media sheets are moved from the input and fed into a primary media path. One or more registration rollers 99 disposed along the media path aligns the print media and precisely controls its further movement along the media path. A media transport belt 20 forms a section of the media path for moving the media sheets past a plurality of image forming units 100. Color printers typically include

four image forming units 100 for printing with cyan, magenta, yellow, and black toner to produce a four-color image on the media sheet.

An imaging device 22 forms an electrical charge on a photoconductive member 51 within the image forming units 100. The media sheet with loose toner is then moved through a fuser 24 that adheres the toner to the media sheet. Exit rollers 26 rotate in a forward direction to move the media sheet to an output tray 28, or rollers 26 rotate in a reverse direction to move the media sheet to a duplex path 30. The duplex path 30 directs the inverted media sheet back through the image formation process for forming an image on a second side of the media sheet.

As illustrated in Figures 1 and 2, the image forming units 100 are constructed of a developer unit 40 and a photoconductor unit 50. The developer unit 40, including a developer member 45, is positioned within the main body 12. The photoconductor unit 50, including a photoconductive member 51, is mounted to the door assembly 13. In a closed orientation as illustrated in Figure 1, the door assembly 13 is positioned adjacent to the main body 12 with the photoconductive member 51 of the photoconductor unit 50 against the developer member 45 of the developer unit 40. In an open orientation as illustrated in Figure 3, the door assembly 13 is moved away from the main body 12 separating the photoconductor unit 50 from the developer unit 40. This configuration provides direct and easy user access to the developer unit 40, photoconductor unit 50, and the media path. It has been determined that the highest user intervention rates are at the developer unit 40, photoconductor unit 50, and media path.

Figure 2 illustrates a cross-sectional view of the image forming unit 100 in the closed orientation. The developer unit 40 comprises an exterior housing 43 that forms a reservoir 41 for holding a supply of toner. One or more agitating members 42 are positioned within the reservoir 41 for agitating and moving the toner towards a toner adder roll 44 and the developer member 45. Toner moves from the reservoir 41 via the one or more agitating members 42, to the toner adder roll 44, and finally is distributed to the developer member 45. The

developer unit 40 is structured with the developer member 45 on an exterior section where it is accessible for contact with the photoconductive member 51.

The photoconductor unit 50 is illustrated in Figure 2 and comprises the photoconductive member 51, and a charger 52. In one embodiment, the photoconductive member 51 is an aluminum hollow-core drum coated with one or more layers of light-sensitive organic photoconductive materials. Charger 52 applies an electrical charge to the photoconductive member 51 to receive an electrostatic latent image from the imaging device 22 (Figure 1). A cleaner blade 53 contacts the surface of the photoconductive member 51 to remove toner that remains on the photoconductive member 51. The residual toner is moved to a waste toner auger 54 and moved out of the photoconductor unit 50. A housing 56 forms the exterior of a portion of the photoconductor unit 50. The photoconductive member 51 is mounted protruding from the photoconductor unit 50 to contact the developer member 45.

In this two-piece cartridge architecture, the developer unit 40 and photoconductor unit 50 are mounted to ensure good contact axially along a developer nip 46 across a print zone between the developer member 45 in the developer unit 40 and the photoconductive member 51 in the photoconductor unit 50. The accurate placement of each of the developer unit 40 and photoconductor unit 50 is important for uniform contact pressure along the full axial extent of the developer nip 46.

As illustrated in Figure 3, the main body 12 has enclosed sides forming an opening 18 for mounting the developer units 40. Developer units 40 are positioned within the opening 18 with the developer roll 45 extending outward to contact the photoconductive member 51 during image formation. Opening 18 may be sized to encompass the entire side of the main body 12, or may comprise only a limited portion of one side. In the embodiment of Figure 3, opening 18 is positioned on a lateral side of the main body 12. Opening 18 may also be positioned on the top or bottom side of the main body 12 depending upon the application.

Door assembly 13 is movably attached relative to the main body 12 between an opened orientation as illustrated in Figure 3 and a closed orientation as illustrated in Figure 1. The door assembly 13 may be attached to the main body 12 in a variety of manners. Figure 3 illustrates one embodiment with the door assembly 13 pivotally attached to the main body 12 through a pivot 14. Pivot 14 may attach the main body 12 and door assembly 13 at a variety of locations, such as towards a lower edge 15. In the open orientation, the door assembly upper edge 16 is spaced from the main body 12. This orientation provides access to the developer units 40, cleaner units 50, and media path. In the closed orientation, the upper edge 16 is in proximity to the main body 12. The upper edge 16 may be in contact with the main body 12, or slightly spaced apart from the main body 12. One or more locks 17 maintain the door assembly 13 in the closed orientation and provide tactile feedback to the user to indicate when the door assembly 13 is in the closed orientation. In one embodiment, a total of four locks 17 connect the door assembly 13 to the main body 12 with two locks each on an upper and lower portion of the opening 18.

The door assembly 13 comprises a first frame 60 and a second frame 61 as illustrated in Figures 4, 5, and 6. The first frame 60 is movably attached to the main body 12, such as at the first pivot 14. The first frame 60 is sized to extend over the opening 18 when the door assembly 13 is in the closed orientation.

The second frame 61 is pivotally attached to the first frame 60 at a second pivot 19. The second pivot 19 allows the second frame 61 to move relative to the first frame 60. Stops 62 extend from the first frame 60 to control the extent of movement of the second frame 61. The second frame 61 includes a first side 64 so the photoconductive members 51 face towards the main body 12 when the door assembly 13 is in the closed orientation. In the closed orientation, the second frame 61 is accurately aligned with the main body 12 such that the photoconductive members 51 are aligned with the developer rolls 45.

The second pivot 19 allows for relative movement between the second frame 61 and the first frame 60. The second frame 61 can move relative to the first frame 60 as the door assembly 13 moves between the open and closed

orientations. The allowable motion between the first frame 60 and the second frame 61 is minimized radially at pivot 19 to maintain positional control of the second frame 61 and photoconductive members 51, but have enough allowable radial movement so as not to impart unwanted forces to the first side 64 when the door assembly 13 is in the closed orientation. Further, the second pivot 19 transmits a force applied from the first frame 60 to the second frame 61 when the door assembly 13 is moved between the open and closed orientations.

As illustrated in Figure 5, the second frame 61 further comprises a contact surface 65 that contacts the main body 12 to accurately position the second frame 61 and attached photoconductive members 51 in the closed orientation. Contact surface 65 contacts a contour surface 70 to position the second frame 61 relative to the main body 12. Accurate location of the second frame 61 causes the attached photoconductive members 51 to be accurately positioned relative to the corresponding developer rolls 45 within the main body 12. In the closed orientation, the accurate alignment places the photoconductive member 51 and developer roll 45 in contact such that toner passes from the developer roll 45 to the photoconductive member 51 for image formation.

The size, shape, and location of the contact surface 65 and the contour surface 70 may vary depending upon the application. In the embodiment illustrated in Figure 7, a transport belt support acts as the contact surface 65. The contact surface 65 is positioned on a lower section of the second frame 61, and aligns with the contour surface 70 positioned on a lower section of the main body 12. The surfaces 65, 70 may also be located on upper or side sections of the door assembly 13 and main body 12 depending upon the application. In one embodiment, the contour surface 70 has a length of about 15mm.

In one embodiment illustrated in Figures 4, 5, and 6, the contour surface 70 has a shape equal to a radius formed by a line with a length R2. Length R2 is the distance between the first pivot 14 and the second pivot 19. In one embodiment, a friction-reducing element (not illustrated) is positioned on the door assembly 13.

Figures 4, 5, and 6 illustrate a schematic progression as the door assembly 13 moves from the open orientation to the closed orientation. The open orientation in Figure 4 includes the upper edges of the first and second frames 60, 61 spaced from the main body 12. The second frame 61 is pivoted downward about second pivot 19 with a lower edge resting on the lower stop 62b and the upper edge being spaced from the upper stop 62a. This orientation may be caused by the weighting of the second frame 61, or by a biasing mechanism 63 that extends between the first frame 60 and the second frame 61. Biasing mechanism 63 acts as a dampener when the contact surface 65 contacts the contour surface 70 at the intermediate orientation, and also allows for a smooth closing motion between the intermediate orientation and the closed orientation.

Movement of the first and second frames 60, 61 from the open orientation to the intermediate orientation is rotational about the first pivot 14. The travel distance of a point on the door assembly 13 increases with the distance from the first pivot 14. Therefore, a first photoconductive member 51a mounted towards an upper edge of the second frame 61 has a greater travel distance than a second photoconductive member 51b mounted towards a lower edge.

Figure 5 illustrates the intermediate orientation when the contact surface 65 first contacts the contour surface 70. Because the second frame 61 is resting against the lower stop 62b when moving from the open orientation to the intermediate orientation, the contact surface 65 is the first part of the second frame to make contact with the main body 12. The first and second developer members 45a, 45b mounted within the main body 12 are spaced from the second frame 61.

Figure 6 illustrates the closed orientation with the photoconductive members 51 positioned adjacent to the developer members 45 for toner to pass during image formation. The second frame 61 moves relative to the second pivot 19 while moving from the intermediate orientation to the closed orientation. This is seen as the lower edge moves away from the lower stop 62b. When the door assembly 13 is in the closed orientation, the photoconductor units 50 are aligned relative to the main body 12. In the closed orientation, the first photoconductive

member 51a is aligned with the first developer member 45a, and the second photoconductive member 51b is aligned with the second developer member 45b.

In one embodiment, the door assembly 13 can be represented by a four-bar linkage when moving between the intermediate orientation and the closed orientation as illustrated in dashed lines in Figures 5 and 6. A first link 101 extends between point A and the first pivot 14. A second link 102 extends between the first pivot 14 and the second pivot 19. A third link 103 extends between the second pivot 19 and the contact surface 65. A fourth link 104 extends between the contact surface 65 and point A.

R2 is the distance between the first pivot 14 and the second pivot 19. R1 is set equal to R2 and defined between the contour surface 70 and point A. The radius R2 defines the shape of the contour surface 70. Because R1 is a discrete length, the contour surface 70 has a curved configuration. As the second frame 61 moves from the intermediate orientation to the closed orientation, the contact surface 65 slides along the contour surface 70 and each of the photoconductive members 51 have substantially the same travel path, including substantially the same angle of approach towards the main body 12, and substantially the same travel distance. Therefore, photoconductive member 51a located most remotely from the first pivot 14 aligns and mates with its respective developer member 45 in the main body 12 in the same manner as photoconductive member 51b.

The travel path of the photoconductive members 51 is not completely horizontal because the contour surface 70 has a curved configuration (if R1 had an infinite length, contour surface 70 would be perfectly horizontal and the travel path would be completely horizontal). Therefore, the photoconductive members 51 have an angle of approach relative to the developer members 45. The highest vertical point may be positioned at any location between the inner and outer edge of the contour surface (i.e., anywhere between the intermediate and closed orientations).

The 4-bar linkage controls the approach of the photoconductive members 51 from the intermediate orientation to the closed orientation. In one embodiment, R1 is equal to R2, and links 102 and 104 are parallel during the

range between the intermediate and closed orientations. The first side 64 stays substantially parallel to the face of the opening 18 where the developer members 45 are located. In one embodiment, the first side 64 is substantially vertical as the door assembly 13 moves from the intermediate to closed orientations, and the first pivot 14 is located vertically below the second pivot 19, and the photoconductive members 51a, 51b are vertically aligned.

When the door assembly 13 is opened beyond the intermediate orientation, the contact between the contact surface 65 moves from the contour surface 70 when 62b contacts 61 and the 4-bar linkage is broken. This motion includes the second frame 61 moving in rotational motion about the first pivot 14.

The contour surface 70 and contact surface 65 may have a variety of shapes and sizes. In another embodiment, the contour surface 70 is approximated to be similar to radius R2. Additionally, manufacturing tolerances may result in the contour surface 70 having a slightly different shape than that mathematically determined as R2. In one embodiment, the contour surface is within 5% of R2. In one embodiment, contour surface 70 is flat.

The term "image forming device" and the like is used generally herein as a device that produces images on a media sheet. Examples include but are not limited to a laser printer, ink-jet printer, fax machine, copier, and a multi-functional machine. One example of an image forming device is Model No. C750 available from Lexmark International, Inc. of Lexington Kentucky.

Another embodiment of a two-piece cartridge and door assembly is disclosed in U.S. Patent Application Serial No. __/_____ (Attorney Docket No. 4670-201) entitled "Movable Subunit and Two Piece Cartridge for Use in an Image Forming Device" filed concurrently herewith, assigned to Lexmark International, Inc., and incorporated herein by reference in its entirety.

The embodiments illustrate a transfer belt 20 used for moving the media sheets past the image forming units 100. In another embodiment, nip rollers are used for holding and propelling the media sheets. Various other forms of media movement devices may also be used in the present invention.

In one embodiment, the photoconductor unit 50 is attached to the door assembly 13 via a plurality of mounts. One embodiment of the structure on the door assembly and photoconductor unit is disclosed in U.S. Patent Application Serial No. __/_____ (Attorney Docket No. 4670-272) entitled "Door Assembly for an Image Forming Device", filed concurrently with the present application, and incorporated herein by reference in its entirety.

Figures 8 and 9 illustrate another embodiment of the invention. One or more image forming units 100 including both developer and photoconductive elements are mounted on the door assembly 13. In one embodiment, the elements of the developer unit 40 and the elements of the photoconductor unit 50 are both contained within a one-piece cartridge that is mounted on the door assembly 13. In the open orientation illustrated in Figure 8, the image forming units 100 are positioned away from the imaging device 22 within the main body 12. In the closed orientation of Figure 9, the door assembly 13 accurately mounts the image forming units 100 within the main body 12.

The present invention may be carried out in other specific ways than those herein set forth without departing from the scope and essential characteristics of the invention. In one embodiment, the upper stop is an over-travel stop that controls the extent of movement of the second frame 61 about the second pivot 19. During normal use, the second frame 61 does not contact the upper stop 62a. In one embodiment, the first side 64 is formed by the transport belt 20. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.